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**THE OPEN UNIVERSITY OF SRI LANKA**

**FACULTY OF ENGINEERING**

**DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING**

**BACHELOR OF SOFTWARE ENGINEERING HONOURS**

**LEVEL : 06**

**EEX5362 – PERFORMANCE MODELLING**

**ACADEMIC YEAR – 2024/2025**

**DELIVERABLE 01**

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**System Performance Analysis Document**

**System Name: Library Book Borrowing and Return System**

# **The System We Are Studying**

**What is this System?**

This is a public library where people come to borrow books and return them. When library members visit, they:

* Search for books they want to read
* Wait in line to borrow books at the counter
* Take books home (for 2 weeks usually)
* Come back to return books at the counter or drop box
* May need to pay late fees if books are returned late

**Why is this System complex?**

* Many people want to borrow books at the same time (especially weekends)
* Some books are very popular and have waiting lists
* Books can be borrowed, returned, or renewed
* Staff must check books in and out, scan them, and update records
* Some books get lost or damaged
* Limited number of staff members at the counter
* The system must track thousands of books and hundreds of members

**What can we measure?**

* How long people wait in line to borrow or return books
* How many books are borrowed each day
* How busy the library staff are
* Which times of day are busiest
* How many books are overdue
* How long it takes to process each book transaction

# **What We Want to Improve (Performance Objectives)**

**Main Goal:**

Make the library work faster so people don’t wait long and more books can be borrow and return quickly.

1. **Reduce Waiting Time in Line**

**What:** How long people stand in line at the counter

**Now:** Around 8 minutes waiting

**Target:** Make it 3 minutes or less

**Why it matter:** People don’t like waiting too long and maybe they go without borrowing

1. **Increase Book Transactions Per Day**

**What:** How many books borrow and return each day

**Now:** About 400 books per day

**Target:** Around 500 books per day (25% more)

**Why it matter:** More members can use the library fast and easy

1. **Find the Bottlenecks**

**What:** See which part of the process is slow

**Example:**

* Maybe book searching take too long?
* Maybe checkout counter is slow?
* Or not enough staff at busy time?

**Why it matter:** If we fix the biggest slow part first, we get best results

1. **Improve Staff Utilization**

**What:** Make sure staff working well (not too busy or too free)

**Target:** Staff work busy around 60–75% of the time

**Why it matter:** Use staff and money smart, and no one get tired too much

1. **Reduce Book Processing Time**

**What:** How long to check or return one book

**Now:** About 2 minutes per book

**Target:** Around 1 minute per book

**Why it matter:** Faster work means shorter lines and happy members

1. **Minimize Overdue Books**

**What:** How many books come back late

**Now:** 15% of books are late

**Target:** Make it under 8%

**Why it matter:** More books available for others to borrow sooner

# **The Data We Will Collect**

**Time Period:** January 2024 – December 2024 (whole year)

We will collect data about every borrow and return that happen in the library.

**What We Collect for Each Transaction:**

|  |  |  |
| --- | --- | --- |
| **Data Item** | **What It Means** | **Example** |
| **Transaction ID** | Unique number for each borrow/return | T-00001 |
| **Member ID** | Code for each library member | M-12345 |
| **Book ID** | Code for each book | B-89456 |
| **Book Title** | Name of the book | Harry Potter and the... |
| **Book Category** | Type of book (Fiction, Non-fiction, etc.) | Fiction |
| **Transaction Type** | Borrow or Return | Borrow |
| **Date** | The date of the transaction | 3/15/2024 |
| **Time** | Time of the transaction | 10:30 AM |
| **Day of Week** | Which day it happen | Saturday |
| **Counter Wait Time** | How long people wait in line | 5 minutes |
| **Processing Time** | Time to scan and complete the work | 2 minutes |
| **Staff Member ID** | Who handled the transaction | Staff-03 |
| **Number of Staff on Duty** | Total staff working that time | 3 people |
| **Due Date** | When book must be returned | 3/29/2024 |
| **Return Status** | On time or late | On time |

**Extra Data We Collect:**

|  |  |  |
| --- | --- | --- |
| **Data Type** | **What It Tracks** | **Example** |
| Peak Hour Data | Busiest times in the day | 3–5 PM weekdays, 10 AM–2 PM Saturdays |
| Queue Length | How many people waiting in line | 8 people |
| Popular Books | Which books are borrowed most | List of top 50 books |
| Member Activity | How often members visit | 2 times per month average |

**Sample Data Size:**

* Around 120,000 transactions in one year
* Around 330 transactions per day
* Around 5,000 active library members
* Around 15,000 books in library

# **How We Will Analyze Performance**

**Steps:**

**Find average waiting times**

* For different times in a day
* For different days of week
* For borrow vs. return

**Find bottlenecks**

* Which time has longest lines?
* Which day is busiest?
* Do some book types take more time?

**Check staff efficiency**

* How many transactions each staff do per hour?
* Are some staff faster than others?
* Do we need more staff at some times?

**Study book movement**

* Which books are most borrowed?
* How long people keep them?
* When are books mostly returned?

**Test new improvement ideas**

* What if we add self-checkout machine?
* What if one more staff work in busy time?
* What if we give 3 weeks borrowing time?

**Success Measures:**

* People wait less than 3 minutes in line
* Process at least 500 books per day
* Staff busy 60–75% of time (not too much, not too little)
* Each transaction take 1 minute or less
* Less than 8% of books are late
* No more than 5 people in line anytime

# **Expected Results**

**We will learn:**

* When the library is most busy
* Which steps are slow
* If more staff is needed and when
* If self-checkout can help
* How to make lines shorter

**We can improve by:**

* Better staff timing during busy hours
* Faster checkout steps
* Maybe add self-checkout machines
* Put popular books in easy-to-find places
* Send reminders to reduce late returns

**Benefits:**

* People happy (less waiting)
* More books borrowed
* Staff less stressed
* Library work smoother and faster
* Less overdue books